

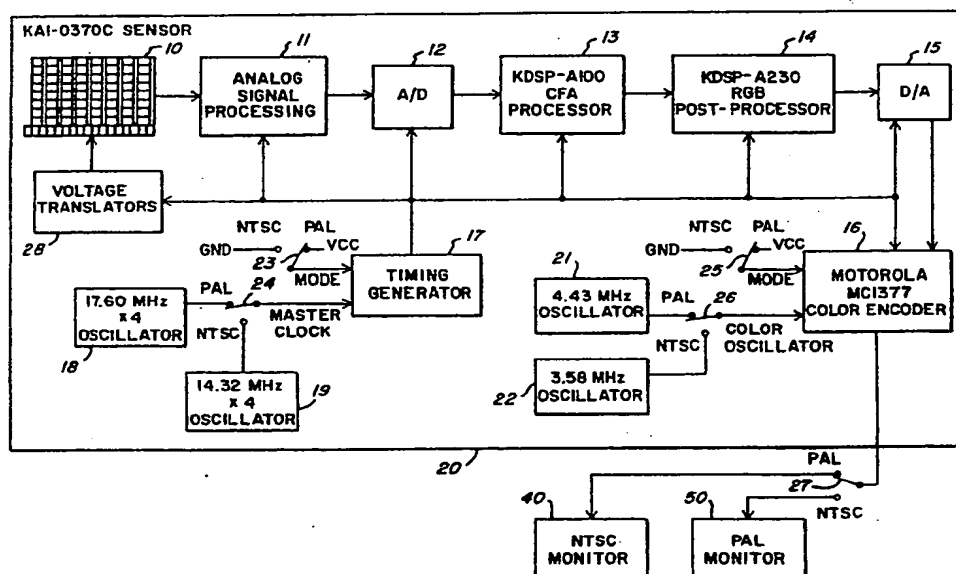


PCT

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : H04N 5/335, 3/15	A1	(11) International Publication Number: WO 92/20187 (43) International Publication Date: 12 November 1992 (12.11.92)
<p>(21) International Application Number: PCT/US92/03474</p> <p>(22) International Filing Date: 28 April 1992 (28.04.92)</p> <p>(30) Priority data: 694,167 1 May 1991 (01.05.91) US</p> <p>(71) Applicant: EASTMAN KODAK COMPANY [US/US]; 343 State Street, Rochester, NY 14650 (US).</p> <p>(72) Inventors: PARULSKI, Kenneth, Alan ; 14 Catalpa Road, Rochester, NY 14617 (US). SHELLEY, Paul, Ralph ; 75 Clio Street, Rochester, NY 14612 (US).</p> <p>(74) Agent: DUGAS, Edward; 343 State Street, Rochester, NY 14650-2201 (US).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent).</p> <p>Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: A DUAL STANDARD CAMERA USING A COMMON CCD SENSOR



(57) Abstract

The present invention is directed to a video camera that uses a common CCD image sensor for providing PAL and NTSC outputs. The image sensor converts a sensed image to corresponding output electrical signals at a rate determined by horizontal and vertical timing signals. A timing signal generator selectively provides a first set of vertical and horizontal timing signals to the image sensor for generating NTSC output signals and a second set of vertical and horizontal timing signals to the image sensor for generating PAL output signals. A processor processes the generated output signals from the timing signal generator to provide processed output signals for display on a monitor either as PAL or NTSC signals.

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A DUAL STANDARD CAMERA USING A COMMON CCD SENSORField Of The Invention

5 The present invention is directed to the field of video cameras and more particularly to an electronic video camera of the type that can generate both PAL and NTSC output signals.

10 BACKGROUND OF THE INVENTION

 There are two major television scanning standards in worldwide use at the present time. They are: The NTSC-M standard, used in the US and Japan, having 525 total TV lines per frame (approximately 484
15 lines are actually displayed) and 59.94 fields per second, and the PAL standard, used in Europe, having 625 total TV lines per frame (approximately 575 lines are actually displayed) and 50.00 fields per second. These television standards are described in detail in
20 "Television Engineering Handbook," Blair Benson, Editor, MacGraw-Hill, New York, 1986.

 Television cameras with tube sensors can be switched between NTSC and PAL line rates, so that they scan the appropriate number of lines per frame, by
25 changing the beam deflection circuitry. Television cameras that use semiconductor image sensors, such as CCD sensors, on the other hand, must be designed with a fixed number of pixels in the vertical and horizontal directions and a fixed picture aspect ratio. To obtain
30 a PAL format signal from a camera employing an NTSC format semiconductor image sensor, an expensive digital "standards converter", which interpolates 575 new active PAL lines from the camera's 484 NTSC lines, and changes the frame rate, has to be used. Such standards
35 converters are available, for example, from AF Associates, Northvale, New Jersey.

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For some non-entertainment applications, however, it is not necessary to display a full screen television image. Instead, displaying a 484 active line 'window' image on a 575 active line PAL monitor
5 may be acceptable, as long as the image is not distorted.

In U.S. Patents Nos. 4,426,664 and 4,811,106 there are disclosed semiconductor sensor arrays, CCD devices, that can operate in at least two modes of
10 frame rate and line scans. These devices are constructed with a number of lines of photosensitive elements corresponding to the highest number of lines to be displayed. Selection circuitry then selects
15 either less than the full number of lines or the maximum number of lines to provide the correct image display.

The present invention provides a simple, low cost video camera which can be switched to generate either PAL or NTSC signals and which uses a standard
20 semiconductor image sensor array, such as a CCD image sensor, without adding additional lines of photoelements to the array, and without requiring special line selection circuitry incorporated on the image sensor.

25

SUMMARY OF THE INVENTION

In the preferred embodiment of the present invention there is provided a PAL/NTSC camera having
30 a common CCD image sensor array for selectively providing PAL and NTSC outputs incorporating an NTSC format image sensor array for converting a sensed image to corresponding output electrical signals at a rate determined by horizontal and vertical timing
35 signals. Additionally, a timing signal generator

selectively provides a first set of vertical and horizontal timing signals to the image sensor array for generating NTSC output signals and a second set of vertical and horizontal timing signals to the
5 image sensor array for generating PAL output signals. The output signals are directed to a processor for providing processed output signals for display on a picture monitor.

When the electronic video camera of the
10 present invention is in the NTSC mode, the camera timing allows the NTSC picture monitor to show the normal full screen image. When the video camera is switched into PAL mode, the camera timing is modified so that the PAL monitor displays a
15 "windowed" 484 line image with the proper aspect ratio and no geometric distortion. This is accomplished by extending both the vertical and horizontal blanking times by 16% and increasing the horizontal sensor clock rate by 16%. The image on
20 the PAL monitor can be centered, or moved to a corner of the screen, to allow text or graphics to be placed outside the window.

From the foregoing it can be seen that it is a primary object of the present invention to
25 provide a video camera that can be switched to provide either PAL or NTSC output signals.

It is a further object of the present invention to provide a video camera which utilizes a semiconductor image sensor and which can be switched
30 to provide either PAL or NTSC output signals.

Yet another object of the present invention is to provide a video camera using an NTSC format image sensor which can provide a PAL output image with no geometric distortion.

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These and other objects of the present invention will become more apparent when taken in conjunction with the following description and drawings wherein like characters indicate like parts and which drawings form a part of the present description.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a block diagram of an NTSC format CCD sensor.

Figure 2 illustrates the number of lines, pixels and aspect ratio required for displaying an image on an NTSC video monitor.

Figure 3 illustrates the displaying of a centered window image from an NTSC format sensor on a PAL video monitor.

Figure 4 illustrates an upper right corner offset window of the image of Figure 3 on the PAL video monitor.

Figure 5 is a block schematic diagram of the preferred embodiment of the present invention.

Figure 6 is a timing diagram showing some signals provided by the timing generator of Figure 5 when providing an NTSC output signal.

Figure 7 is a timing diagram showing some signals provided by the timing generator of Figure 5 when providing a PAL output signal with a centered window image.

Figure 8 is a timing diagram showing some signals provided by the timing generator of Figure 5 when providing a PAL output signal with an upper right corner offset window image.

DETAILED DESCRIPTION OF THE INVENTION:

Figure 1 illustrates an NTSC format CCD sensor 10 which may be a Kodak KAI-0370C sensor

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manufactured by Eastman Kodak Company, Rochester, New York. The sensor 10 has 484 vertical by 768 horizontal active photosites and a 4:3 aspect ratio to create the NTSC format image shown in Figure 2. While the present invention is described relative to the KAI-0370C sensor, any other NTSC format sensor may be used. The number of active lines and the picture aspect ratio of the sensor 10 are chosen to be compatible with the RS-170A 'NTSC' standard, such that properly encoded signals from this sensor can be displayed on an NTSC monitor 40 (illustrated in Figure 5). The display update rate of NTSC monitor 40 is 59.94 fields per second, where two interlaced fields, each composed of 242 displayed lines, comprise one frame. The number of active lines of the CCD sensor 10 is equal to the number of displayed lines of monitor 40. The number of horizontal pixels in an NTSC image sensor is somewhat arbitrary, although there are advantages to choosing this number such that the sensor horizontal readout frequency is a multiple of the NTSC color sub-carrier frequency, which is approximately 3.58 MHz. The sensor horizontal readout frequency depends on the number of pixels and the active line period during which the pixels are read out, which for the RS-170A standard is approximately 52.46 microseconds. The KAI-0370C clock frequency used for NTSC display is equal to four times the NTSC subcarrier frequency, or approximately 14.32 MHz.

The PAL-B color television standard is also based on a 4:3 picture aspect ratio, but employs approximately 575 active lines, instead of the 484 active lines used in NTSC (Figure 3). The PAL-B display update rate is exactly 50.00 fields per second, and the active line time is approximately 51.95 microseconds. Because there are fewer active lines in

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the NTSC sensor than in the PAL display, there is no way to create a full screen image on a PAL display from the NTSC sensor, unless the extra lines are digitally interpolated in an NTSC to PAL standards converter, which is an expensive and unattractive solution in this application.

The inventors of the present invention have recognized, however, that for many scientific and medical applications, it is not necessary to have a full screen image on the PAL display. Instead, the 484 active lines from the NTSC sensor can be directly displayed on 484 PAL lines, and the remaining 91 active lines on the PAL display can be set to black, or used for other purposes. However, it is critical that the displayed 484 line image on the PAL monitor be stable, and contain no geometric distortion. One way to provide a viewable image on a PAL monitor from the KAI-0370C NTSC sensor is to read out the 484 lines of the image sensor during the middle 484 lines of the PAL display, using a clock frequency equal to the number of horizontal pixels divided by the PAL active line time, which equals approximately $768/0.00005195$, or 14.78 MHz. Unfortunately, the displayed image would show severe geometric distortion, since it would be compressed in the vertical direction by a factor equal to $(575-486) / 575 = 16\%$, but would be uncompressed in the horizontal direction. Thus, the displayed picture aspect ratio would be wrong, and objects would be displayed much wider than they really are.

The inventors of the present invention have recognized that in order to prevent geometric distribution, the horizontal dimension of the image from the NTSC sensor on the PAL monitor must be equal to $484/575$ times the PAL active display width. This is true because in order to display an undistorted image

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on a PAL monitor, the image aspect ratio of the display must equal that of the image as captured by the sensor, which is 4:3. Since the picture on the PAL display from the NTSC sensor is compressed by about 16% in the vertical direction, because only 484 out of 575 lines are displayed, the picture must also be compressed by the same 16% factor in the horizontal direction, in order to prevent geometric distortion. This is accomplished by shortening the line time corresponding to the actual sensor readout time by 16%, such that $(51.95 - (\text{shortened active line time})) / 51.95$ equals 0.16, so the shortened sensor readout time equals 43.64 microseconds. The proper horizontal clock frequency for the KAI-0370C sensor needed to obtain an undistorted PAL display therefore equals approximately $768 / 0.00004364$, or approximately 17.60 MHz. Using this method to choose the horizontal clock frequency for any NTSC format sensor, the PAL display will appear as shown in Figure 3. The outer 16% of the PAL display will be black due to blanking, but the image in the center of the screen will be properly displayed. The 17.60 MHz clock frequency provides 912 pixel clock periods during the PAL-B active line period.

By adjusting the beginning of the sensor readout period relative to the PAL line and field synchronization signals, it is possible to move the location of the center image 'window' anywhere in the display. Furthermore, by properly switching in the proper video signal levels, it is possible to set the displayed area outside the image 'window' to be any color desired, or to add text or graphics to this outer window, as shown in Figure 4. The circuitry needed to generate the text and the color background referenced with respect to Figure 4 is not described in detail in this specification, since such circuits are well known

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in the art, being incorporated into standard broadcast video products manufactured by Ampex, Redwood City, California, and others.

Figure 5 illustrates the combination of an NTSC/PAL camera 20 which uses an KAI-0370C NTSC format sensor 10, a model KDSP-A100 CFA processor 13, and a model KDSP-A230 RGB post-processor 14, which are manufactured by Eastman Kodak Company, Rochester, New York, and which are described in the publication "A Digital Color Imaging System using Custom VLSI Circuits", authored by K.A. Parulski, et. al., IEEE Trans. on Consumer Electronics, Vol. 35, No. 3, pp. 382-389, Aug. 1989. Also included in the camera 20 is a timing generator 17 which can be an integrated circuit of the type described in "The EBS-1, an EPROM-Based Sequencer ASCI," CICC '88 Technical Digest, pp. 15.6.1-15.6.4, May 1988, and a color encoder 16 which can be an integrated circuit NTSC/PAL encoder model MC 1377 available from Motorola, Inc., Phoenix, Arizona. Additionally, there is provided an analog signal processor 11, an A/D converter 12, a 3-channel D/A converter 15 and four selectable oscillators, 18, 19, 21, and 22 which provide the labeled output signals when selected by switches 24 and 26. The camera 20 can be switched from providing an NTSC signal for driving the NTSC monitor 40 to providing a PAL signal for driving a PAL monitor 50. This can be controlled by the switches labeled 23-27. For operator convenience, switches 23-26 may be ganged together to form one user controlled switch.

The sensor 10 receives different control signals from the timing generator 17 through voltage translators 28, depending on the status of the PAL/NTSC mode switch 23. The voltage translators

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convert the 0 to 5 volt logic signals supplied by timing generator 17 to the appropriate voltage levels required by sensor 10, for example -8 to +7 volt signals for the vertical CCD clocks, ΦV , and -9 to +2 volts for the horizontal CCD clocks, ΦH , using circuits well-known to those skilled in the art. The timing generator 17 is programmed to generate the appropriate timing signals for NTSC or PAL operation of the sensor 10 and all the other major camera components, when switches 23 and 24 are set properly.

Figure 6 shows the signals supplied by timing generator 17 to the sensor 10 in the NTSC mode. Timing waveforms 102 and 104 control when the 489 lines of photoelements of the KAI-0370C sensor (484 active lines plus 5 lines of light shielded pixels) are transferred to the horizontal register 9 in Figure 1, by controlling the vertical clocks $\Phi V1$ and $\Phi V2$ supplied to sensor 10. Waveforms 102 and 104 include 495 pulses per frame because 6 additional clock phases per frame are needed to transfer the 489 lines of photoelements into the horizontal readout registers. Waveforms 106, 108, 110, and 112 show $\Phi V1$ and $\Phi V2$ in greater detail during the odd field and even field vertical blanking intervals. "Third level" pulses 107 and 111 control the transfer of the photodiode signal charge to the vertical transfer registers 7 in Figure 1. Pulses 109 and 113 indicate that the first line of light shielded pixels is transferred to the horizontal register 9 at the start of video Line Number 17 of the odd and even fields, so that the active video image is available at the end of the normal NTSC vertical blanking interval.

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Waveforms 114 and 116 show Φ_{VI} and Φ_{V2} in greater detail during the period corresponding to one NTSC line. Waveforms 120 and 122 show how horizontal clocks Φ_{H1} and Φ_{H2} are controlled in order to read out the charge in the horizontal register 9 via a floating diffusion output structure 8 shown in Figure 1. Φ_{H1} and Φ_{H2} are cycled high and low 791 times in order to read out the 768 photoactive pixels, 12 dark reference pixels, 9 leading empty shift register phases, and 2 trailing empty shift register phases, as indicated by line content diagram 126. Φ_R signal 124 is used to reset the floating diffusion output structure 8 of Figure 1 after each pixel transfer is complete.

Timing waveforms 120, 122, and 124 indicate that Φ_{H1} , Φ_{H2} and Φ_R operate at a 14.32 MHz clock frequency, and that Φ_{H1} and Φ_{H2} are active for approximately 55.3 μ secs, so that the active video image is read out during the normal NTSC active video line period.

Figure 7 shows the signals supplied by timing generator 17 to the sensor 10 in the PAL mode, with a "centered" image window as shown in Figure 3. Timing waveforms 202, 204, 206, 208, 210 and 212 control when the 489 lines of photoelements of the KAI-0370C sensor are transferred to the horizontal register. Since there are 45 fewer lines per field on the KAI-0370C sensor compared to PAL format sensors, the first line transfer of each field, is delayed by an additional 23 lines until Line Number 45, as indicated by pulses 209 and 213, to provide a vertically centered image.

Timing waveforms 214, 216, 220, 222, and 224 show the 64.0 μ sec. PAL line time in more detail. Waveforms 220 and 222 show how the

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horizontal clocks $\Phi H1$ and $\Phi H2$ are cycled high and low 791 times in a period of 44.9 $\mu\text{sec.}$, corresponding to a horizontal clock frequency of 17.60 MHz, during the middle of the PAL line.

5 Figure 8 shows the timing signals supplied by timing generator 17 to the sensor 10 in the PAL mode, with an "upper right corner offset" window image. Either the timing generator 17 can be programmed to supply these signals in the PAL mode, instead of those shown in Figure 7, or else a switch input to timing generator 17 (not shown) can be used to select whether the signals in Figure 7 (corresponding to the centered PAL window in Figure 3) or the signals in Figure 8 (corresponding to the offset PAL window in Figure 4) are used when in the PAL mode.

Timing waveforms 302, 304, 306, 308, 310 and 312 show that the first line transfer of each field occurs at Line Number 22, as indicated by pulses 309 and 313, so that the image is displayed at the top of the PAL monitor, with 45 black lines per field at the bottom of the display.

Timing waveforms 314, 316, 320 and 322 show the 64.0 $\mu\text{sec.}$ PAL line time in more detail. Waveforms 320 and 322 show how the horizontal readout period is shifted to the end of the active line period, instead of the middle of the line period as was the case with waveforms 220 and 222 in Figure 7. Selection of Line Numbers between 22 (Figure 7) and 67 for the first line transfer will move the image (as a function of the selected Line Number) from the top to the bottom of the screen.

The color encoder 16 is designed to create either PAL or NTSC color signals, when the PAL/NTSC mode switch 25 is properly set, when the RGB signals

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from D/A converter 15 follow the proper PAL or NTSC scanning standards, and when the proper color sub-carrier frequency is applied to the color oscillator input to the encoder 16 via the switch 26. Viewing
5 of the output on either the NTSC monitor 40 or the PAL monitor 50 is controllable by the position of switch 27.

Instead of controlling the PAL/NTSC feature via user selectable switches, it is possible
10 to instead make it factory setable by inserting into the PC board that incorporates the electronics represented by the blocks in Figure 5, only the oscillators and jumper wires for either the PAL or the NTSC mode of operation.

15 While there has been shown what is considered to be the preferred embodiment of the invention, it will be manifest that many changes and modifications may be made therein without departing from the essential spirit of the invention. It is
20 intended, therefore, in the annexed claims, to cover all such changes and modifications as may fall within the true scope of the invention.

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We Claim:

1. A PAL/NTSC camera selectively providing PAL and NTSC outputs comprising:
 - 5 an NTSC format image sensing array for converting a sensed image to corresponding output electrical signals at a rate determined by horizontal and vertical timing signals;
 - generator means for selectively providing a
 - 10 first set of vertical and horizontal timing signals to said image sensor for generating NTSC scanning rate output signals and a second set of vertical and horizontal timing signals to said image sensor for generating PAL scanning rate output signals; and
 - 15 processing means for processing the generated output signals from said generator means to provide processed output signals for display on a picture monitor.
- 20 2. The PAL/NTSC camera having a common CCD sensor for selectively providing PAL and NTSC outputs according to Claim 1 and further comprising:
 - a color encoder means for selectively
 - providing PAL and NTSC composite color signals from
 - 25 said processing means.
3. A video camera comprising:
 - an image sensor array for transforming an
 - image impinging thereon into corresponding electrical
 - 30 signals including vertical and horizontal readout means controlled by clocking signals;
 - means for processing said electrical signals for presentation to a picture monitor to cause said monitor to display the resulting image; and

means for controlling said vertical and horizontal readout means of said sensor to provide a full screen image display on a picture monitor employing a first type of scanning standard, and means
5 for controlling said vertical and horizontal readout means to provide a less than full screen display on a picture monitor employing a second type of scanning standard.

10 4. The video camera according to Claim 3 further incorporating means for processing said electrical signals comprised of:

an analog signal processor for forming the electrical signals into color signals;

15 analog to digital converter means for converting the signals from said analog signal processor into corresponding digital signals; and

means for processing said digital signals.

20 5. The PAL/NTSC camera having a common CCD sensor for selectively providing PAL and NTSC outputs according to Claim 2 and further comprising:

a first oscillator means for generating a PAL subcarrier signal;

25 a second oscillator means for generating an NTSC subcarrier signal; and

switching means for selectively connecting said PAL subcarrier signal or said NTSC subcarrier signal to said color encoder means according to the
30 display desired.

6. A video camera comprising:

an image sensor array having a fixed number of active lines per frame and a fixed aspect ratio and

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including vertical and horizontal readout means controlled by clocking signals;

means for controlling said vertical and horizontal readout means of said sensor to provide a
5 sensor output signal including a displayed image window having said fixed number of active lines per frame and said fixed aspect ratio;

means for processing said sensor output signal to provide a camera output signal for
10 presentation to a picture monitor wherein said camera output signal uses a scanning standard with substantially more than said fixed number of active lines per frame.

15 7. The apparatus in Claim 6 wherein said camera output signal uses the PAL scanning standard with approximately 575 active lines per frame.

20 8. The apparatus in Claim 6 wherein the displayed image window is offset from the center of the picture monitor.

25 9. The apparatus in Claim 6 where the displayed image window can be moved to a plurality of positions.

10. A video camera comprising:
an image sensor array having approximately 484 active lines per frame and a 4:3 aspect ratio and
30 including vertical and horizontal readout means controlled by clocking signals;
means for controlling said vertical and horizontal readout means of said sensor to provide a sensor output signal including a displayed image window
35 having approximately 484 lines per frame and a 4:3

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aspect ratio; means for processing said sensor output signal to provide a camera output signal for presentation to a picture monitor wherein said camera output signal uses a scanning standard with

5 substantially more than 484 active lines per frame.

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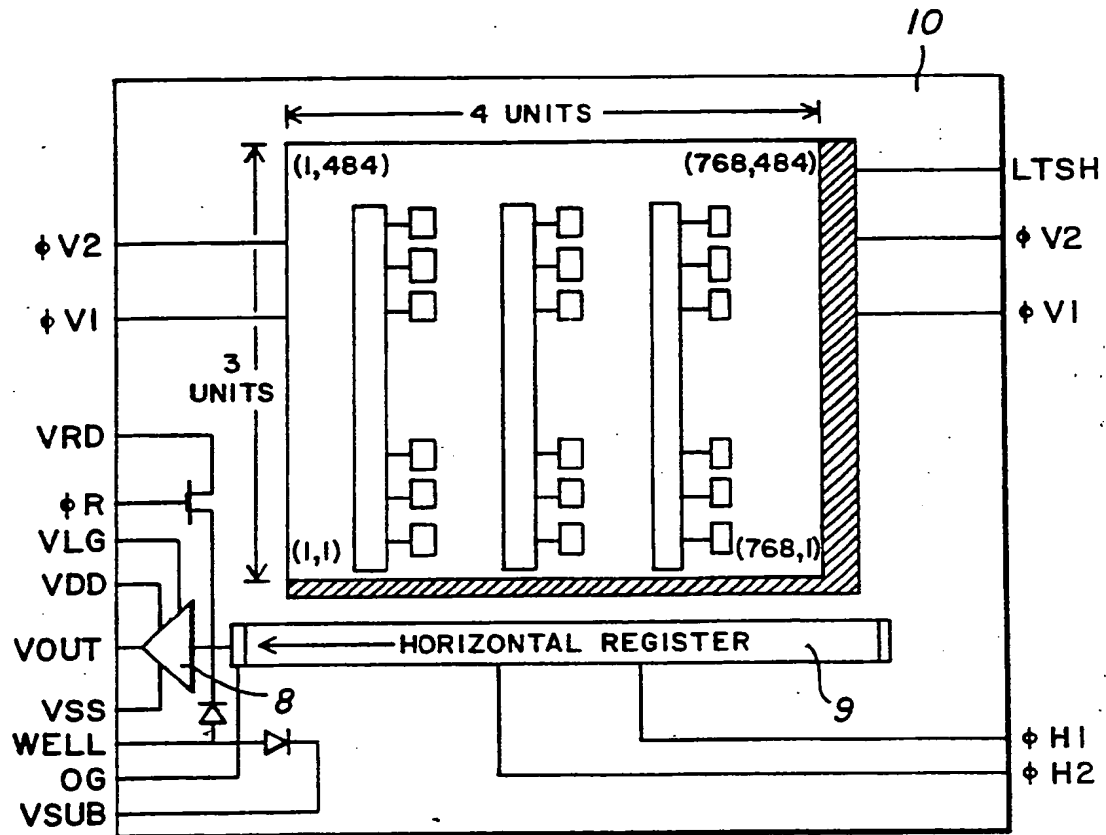


FIG. 1

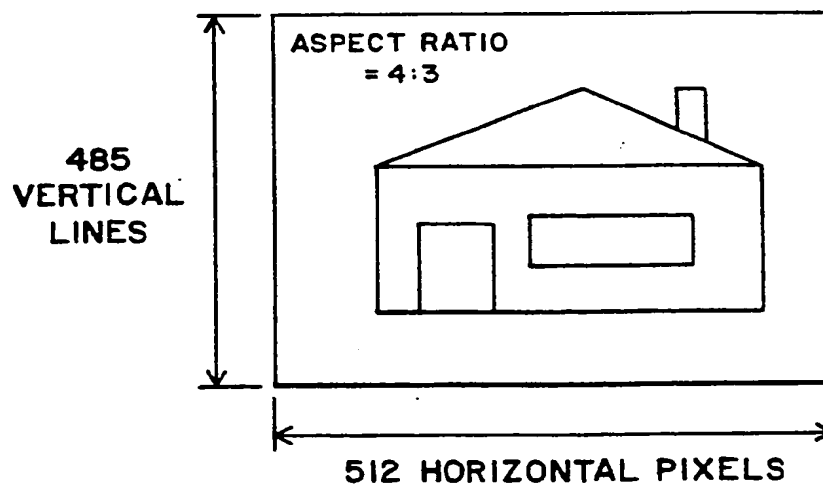


FIG. 2

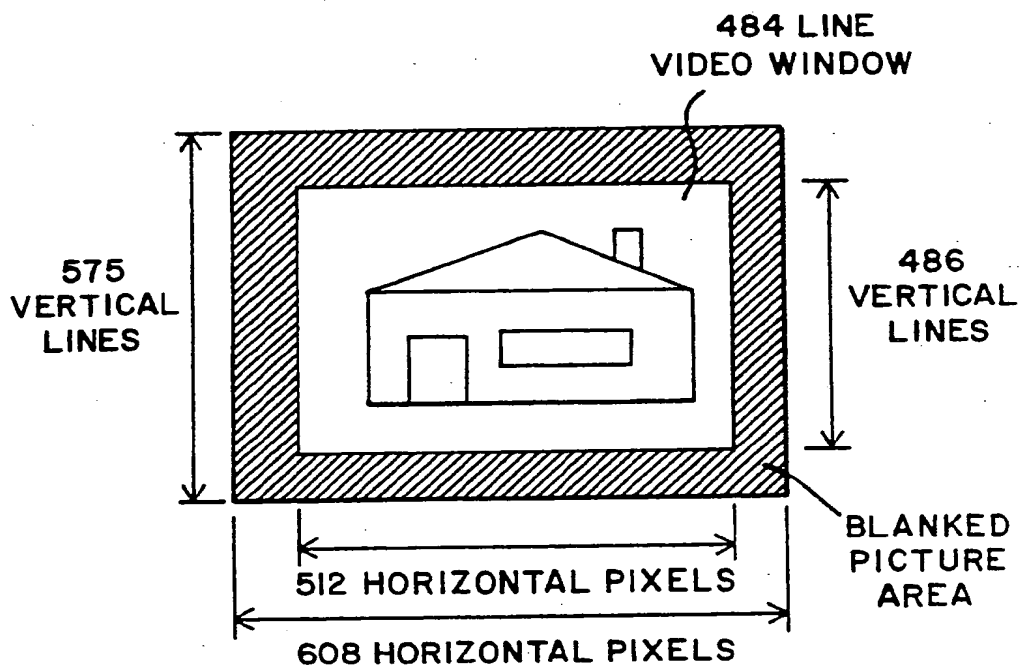
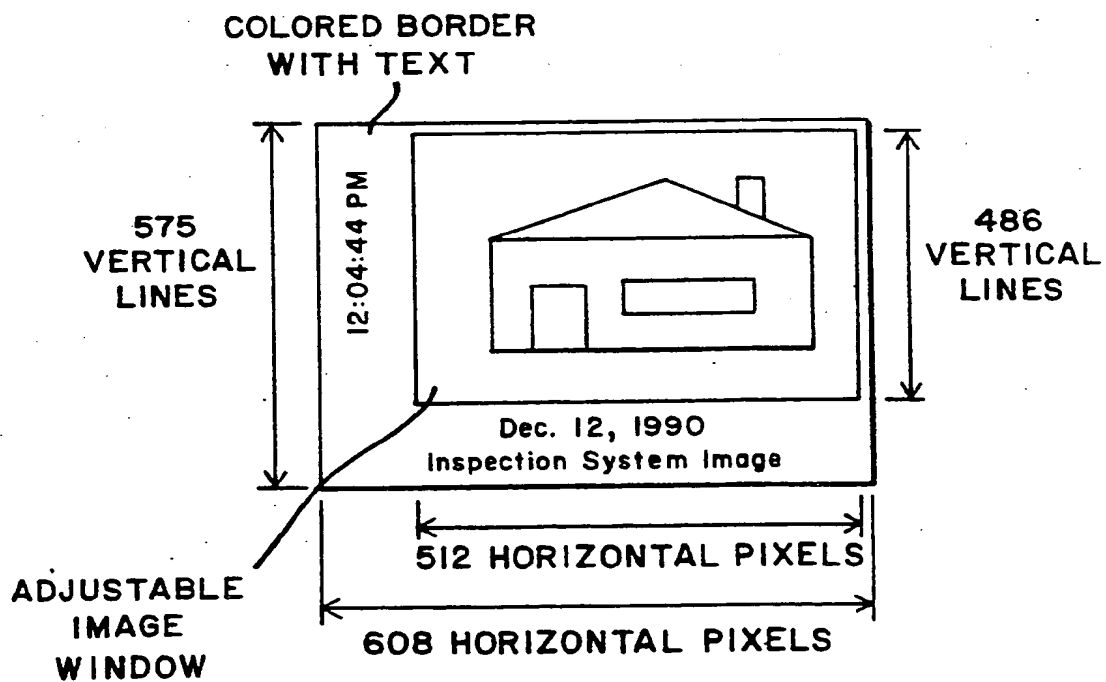
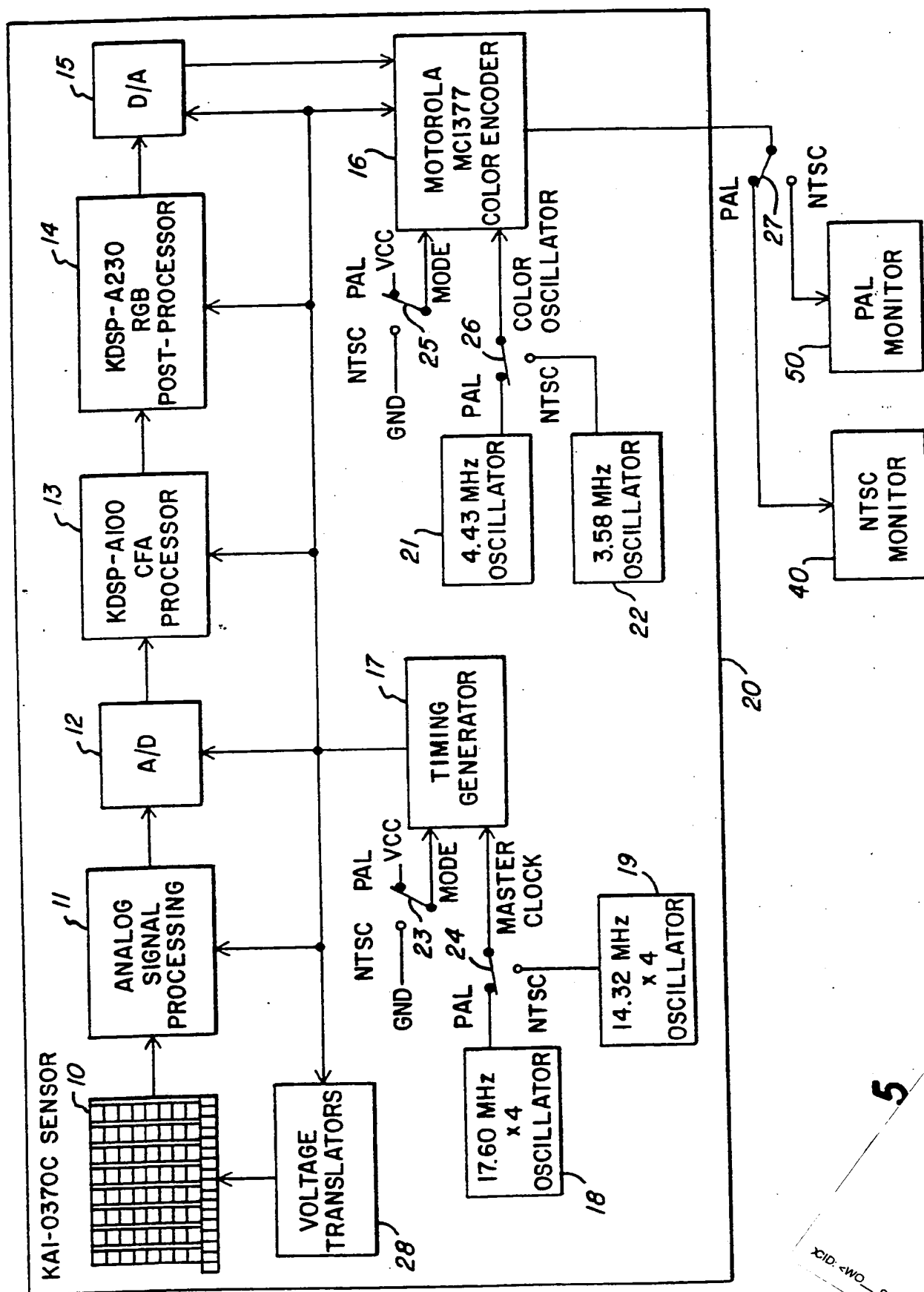


FIG. 3

FIG. 4





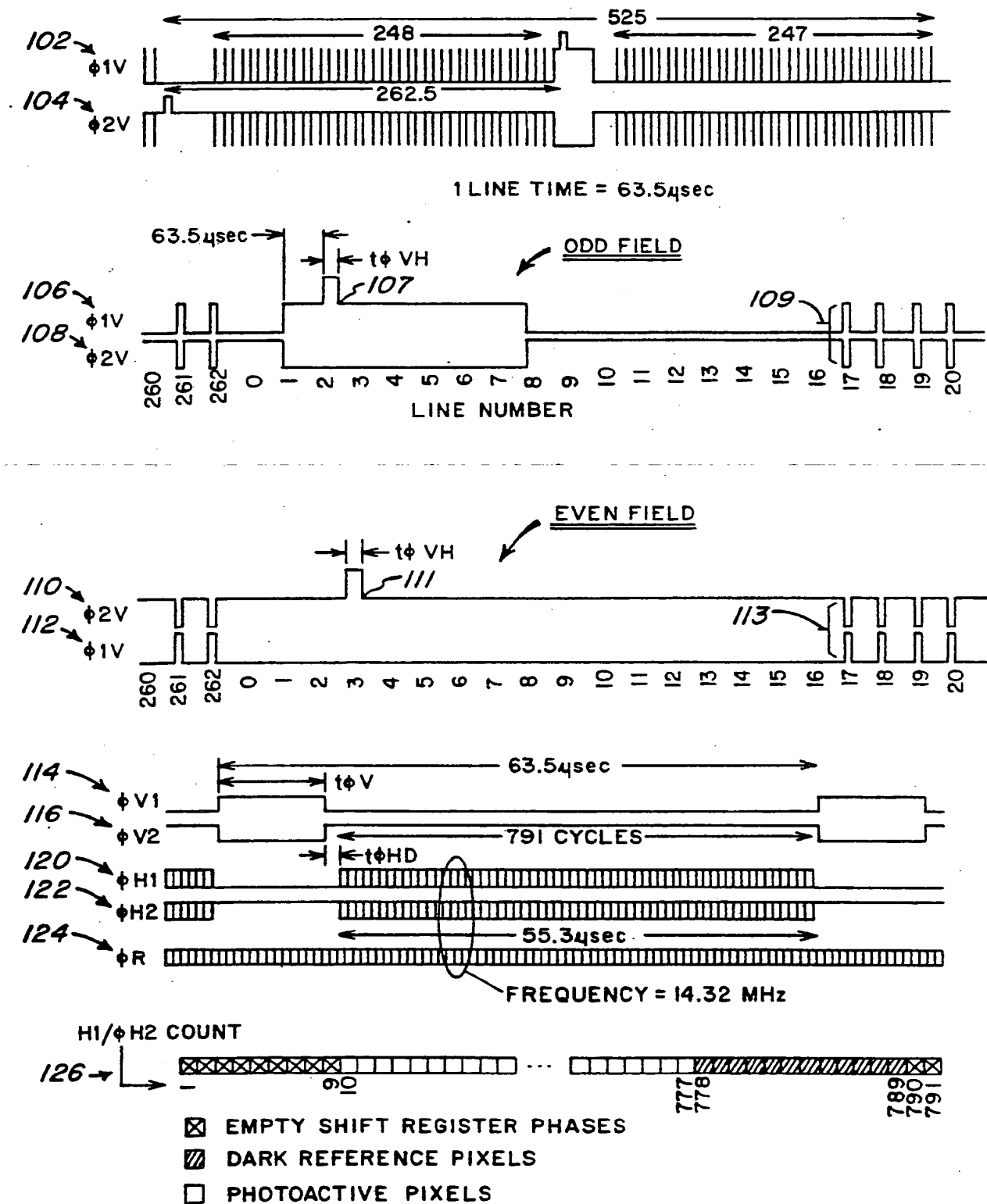
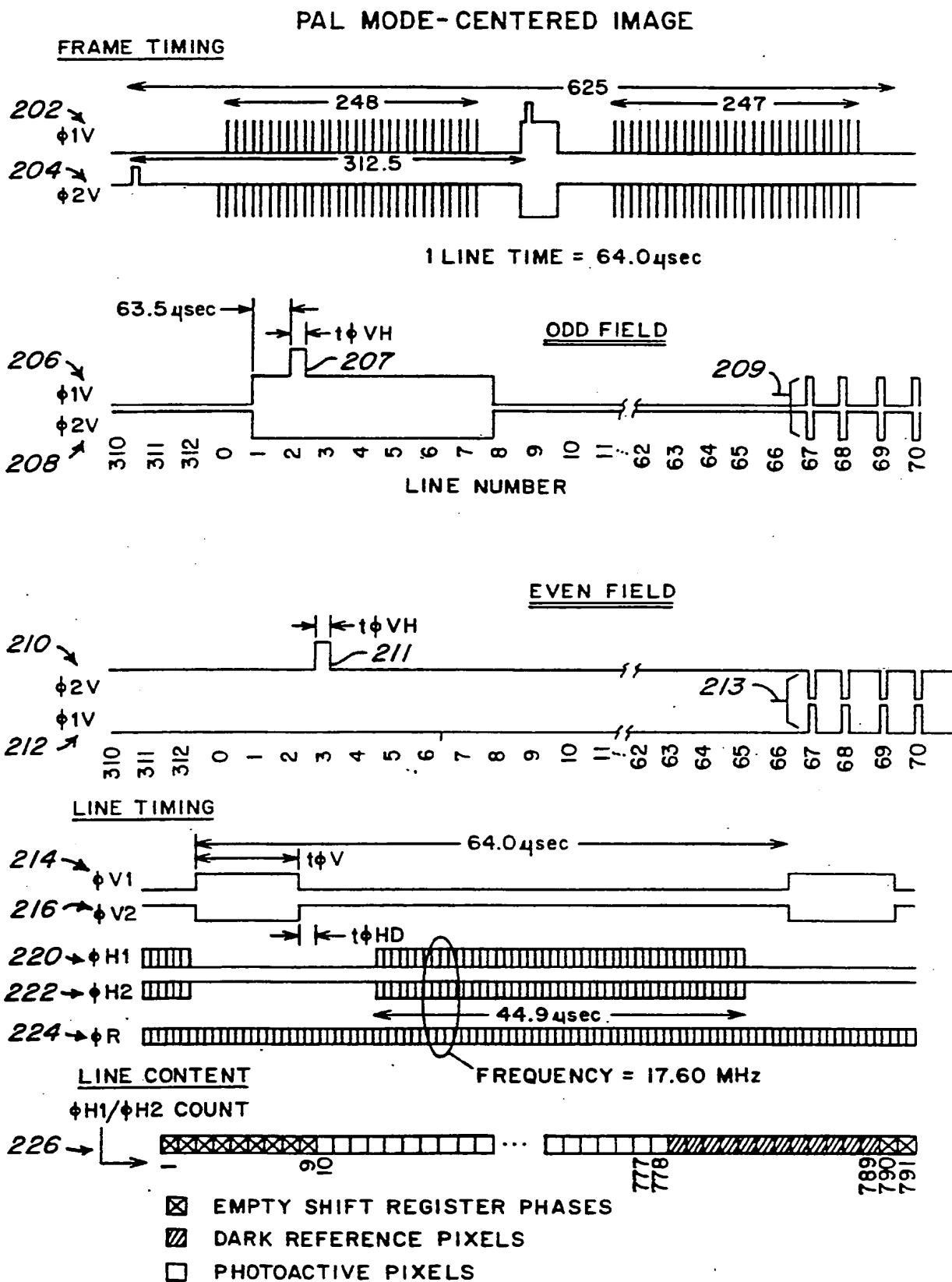


FIG. 6

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**FIG. 7**

PAL MODE-UPPER RIGHT IMAGE

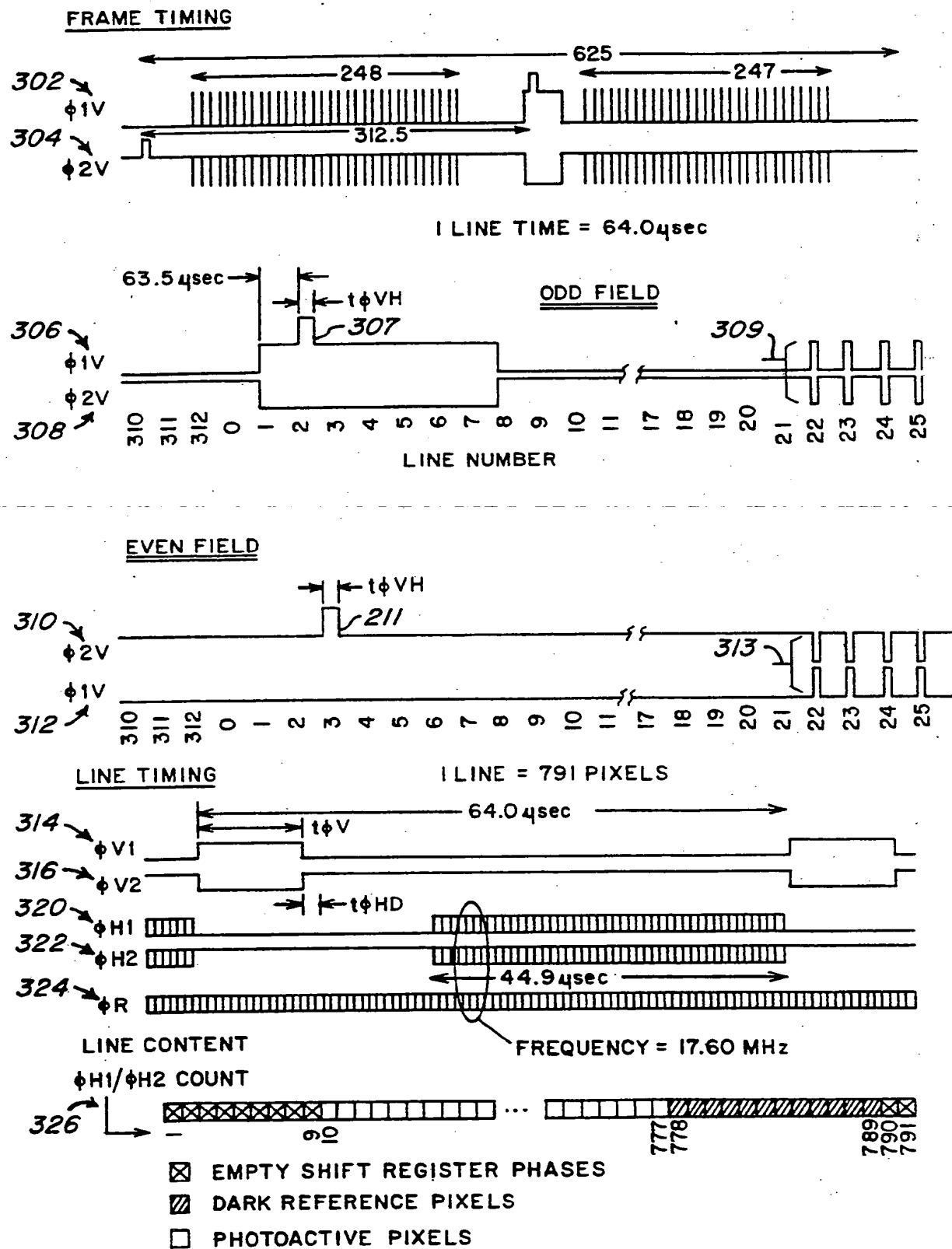
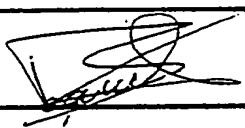


FIG. 8

INTERNATIONAL SEARCH REPORT

International Application

PCT/US 92/03474

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 H04N5/335; H04N3/15		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	H04N	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US,A,4 292 653 (ROBERT BOSCH GMBH) 29 September 1981 see column 1, line 16 - line 28	1-4,6,7, 10
A	---	5,8,9
A	DE,A,3 714 631 (OLYMPUS OPTICAL CO.) 12 November 1987 see column 4, line 67 - column 5, line 7 see abstract	8,9
P,A	---	1-4,6,7, 10
	FR,A,2 659 183 (VISUEL PLUS) 6 September 1991 see page 3, line 14 - page 4, line 4 see page 10, line 17 - line 22 -----	
<p>¹⁰ Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed</p> <p>"I" later document published after the international filing date, or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 29 SEPTEMBER 1992		Date of Mailing of this International Search Report 08.10.92
International Searching Authority EUROPEAN PATENT OFFICE		Signature of Authorized Officer BEQUET T.P. 

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. US 9203474
SA 59998**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4292653	29-09-81	DE-A- 2913116 JP-A- 55135473	23-10-80 22-10-80
DE-A-3714631	12-11-87	JP-A- 62261332 US-A- 4819065	13-11-87 04-04-89
FR-A-2659183	06-09-91	None	